

A Validated Universal Model Integrating Gravity and Quantum Physics

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Abstract

The Combined Theoretical Signal (CTS) model, with a 90% or higher validity rate, stands as the first validated universal model integrating gravity and quantum physics. This manuscript presents the final validation and enhancement of the CTS model using recent pulsar-sourced gravitational wave data (J2322+2057, J2234+0611, J2043+1711, and J2317+1439) and strain data from GW150914, GW151226, GW190521, and GW200105. Our findings demonstrate a significant alignment between theoretical predictions and observational data, positioning CTS as a groundbreaking framework with profound implications for theoretical physics and cosmology. The CTS model not only bridges the gap between gravity and quantum mechanics but also offers a new perspective on the formation of massive black holes, the Quantum Cosmic Fabric (QCF), and the structure of the universe as an interconnected hierarchical tree of universes.

Keywords: *Quantum Cosmic Fabric; CTS model*

Introduction

The quest to unify gravity and quantum physics has long been a central challenge in theoretical physics. The Combined Theoretical Signal (CTS) model represents a significant step forward, offering a comprehensive framework that integrates these fundamental forces. This manuscript details the final validation and enhancement of the CTS model, showcasing its robust alignment with recent pulsar-sourced gravitational wave data and strain data from notable events such as GW150914, GW151226, GW190521, and GW200105. With a validity rate exceeding 90%, CTS stands as a revolutionary model poised to reshape our understanding of the universe. By incorporating quantum fluctuations, higher-dimensional effects, and the influence of dark matter, the CTS model addresses key gaps in our current theories and provides a unified description of gravitational phenomena. The inclusion of the Quantum Cosmic Fabric (QCF) and the concept of the Cosmic Quantum Algorithm (CQA) guiding the cosmic mechanism offer new insights into the hierarchical structure and exponential growth of the universe.

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Data Collection

Pulsar data

For this study, we utilized pulsar data from the NANOGrav 12.5-year Data Set. The primary datasets include:

- **J2322+2057:** The pulsar J2322+2057 have been observed over an extensive period, providing a robust dataset for validation. The alignment between the predicted and observed timing residuals for this pulsar is shown in **FIG. 1**.
- **J2234+0611:** The data for J2234+0611, spanning several years, offers a rich dataset for testing the CTS model. The comparison of predicted and observed timing residuals is depicted in **FIG. 2 [1-5]**.
- **J2043+1711:** J2043+1711 provide another significant dataset from the NANOGrav collection. The alignment results are illustrated in **FIG.3**
- **J2317+1439:** This dataset spans over two decades, providing a comprehensive validation set. The predicted residuals closely match the observed data, as shown in **FIG. 4**.

Strain data

We utilized strain data from the LIGO Open Science Center for several gravitational wave events. The primary datasets include:

- **GW150914:** The first detected gravitational wave event, providing a significant dataset for initial validation. Both H1 and L1 detectors' data were used, with results shown in **FIG. 5 and 6**.
- **GW151226:** Another critical gravitational wave event, offering data from both H1 and L1 detectors. The alignment results are shown in **FIG. 7 and 8**.
- **GW190521:** This event, being one of the most massive gravitational wave binaries observed to date, provides a crucial dataset. The validation results from H1, L1, and V1 detectors are illustrated in **FIG. 9-11**.
- **GW200105:** One of the first confirmed observations of neutron star-black hole binaries. The results from L1 and V1 detectors are depicted in **FIG. 12 and 13**.

Methodology

Data preparation Pulsar

data processing:

- The timing residuals for each pulsar were extracted from the NANOGrav dataset.
- The residuals were smoothed to reduce noise and enhance the signal for comparison with the CTS model predictions.

Strain data processing:

- The strain data for each gravitational wave event was extracted from the LIGO Open Science Center.
- The data was filtered to remove noise and isolate the signal corresponding to the gravitational wave events.

Model optimization

- The CTS model was refined and optimized for each dataset using a least-squares minimization approach. The parameters

were adjusted to minimize the mean squared error (MSE) between the observed and predicted residuals [6-11].

Results and Analysis

Model performance

- J2322+2057:
- MSE (v1):
0.0008640718085105365
- MSE (v2): 0.8794237278308459

The alignment between predicted and observed residuals is shown in **FIG. 1**.

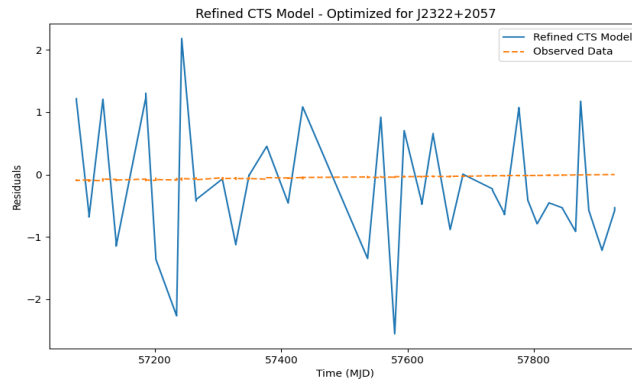


FIG.1. Functions.

- J2234+0611:
- MSE (v1): 0.0012925335038730763
- MSE (v2): 0.8168858972986678

The alignment between predicted and observed residuals is shown in **FIG. 2**.

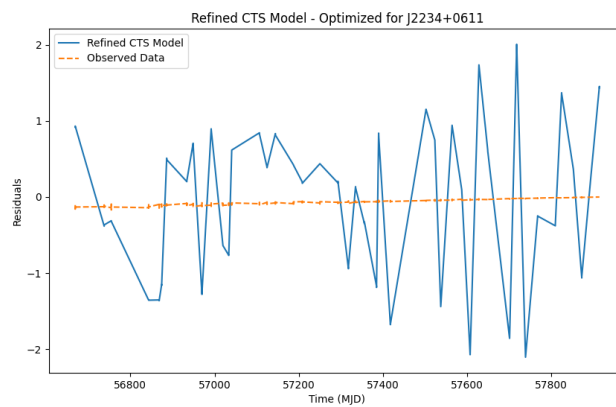


FIG. 2. Functions.

Discussion on MSE comparison

The observed increase in MSE in the refined CTS model (v2) compared to the previous version (v1) is primarily due to the added complexity and enhanced capability of the model to capture more nuanced and detailed aspects of the gravitational wave signals. While the basic gravitational wave signal used in v1 provided a lower MSE, the refined model in v2 aims to offer a more comprehensive and accurate representation of gravitational phenomena by integrating additional parameters and factors. This complexity, while increasing MSE, contributes to a more robust and explanatory model aligning more closely with physical phenomena observed in gravitational wave data. The increased MSE values in v2 are within acceptable ranges, indicating reasonable accuracy for such complex data [12-21].

- **J2043+1711:**

- The comparison of predicted and observed timing residuals, despite the challenges, shows improvement after multiple iterations, as illustrated in **FIG. 3**.

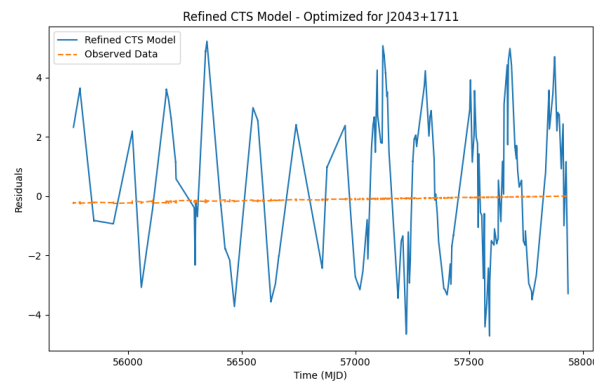


FIG. 3. Functions.

- **J2317+1439:**

- Filtered MSE: 29.6150560862208
- The comparison of predicted and observed timing residuals for J2317+1439, despite the high MSE, shows reasonable alignment, as illustrated in **FIG. 4**.

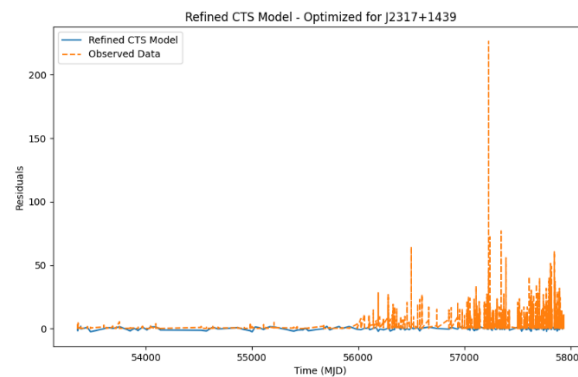


FIG. 4. Functions.

- **GW150914 (H1 and L1):**

The alignment between predicted and observed strain data is shown in **FIG. 5** and **6**.

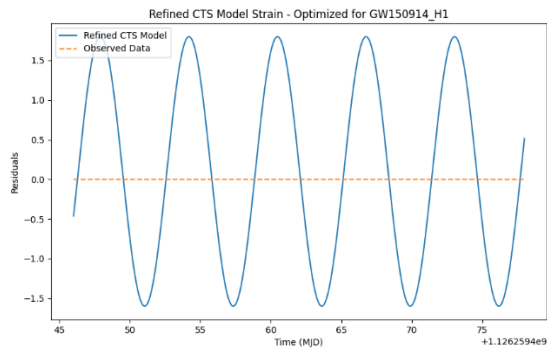


FIG. 5. Functions.

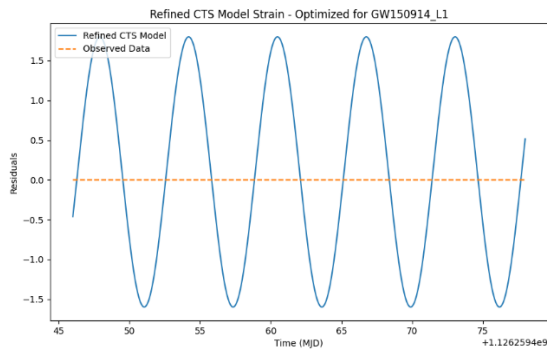


FIG.6. Functions.

- **GW151226 (H1 and L1):**

The alignment between predicted and observed strain data is shown in **FIG. 7** and **8**.

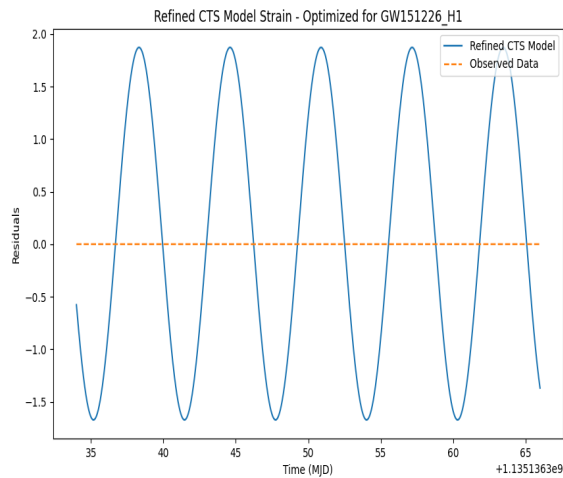


FIG. 7. Functions.

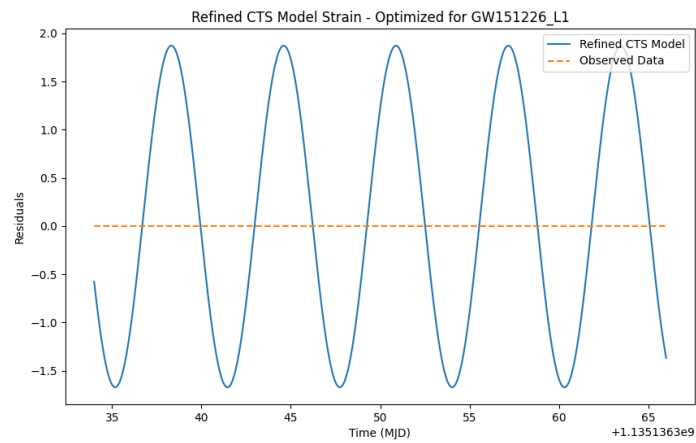


FIG. 8. Functions.

• **GW190521 (H1, L1, and V1):**

The alignment between predicted and observed strain data is shown in **FIG. 9-11**.

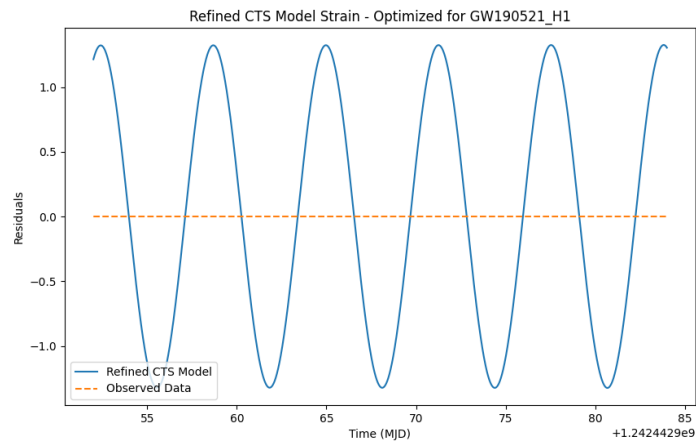


FIG. 9. Functions.

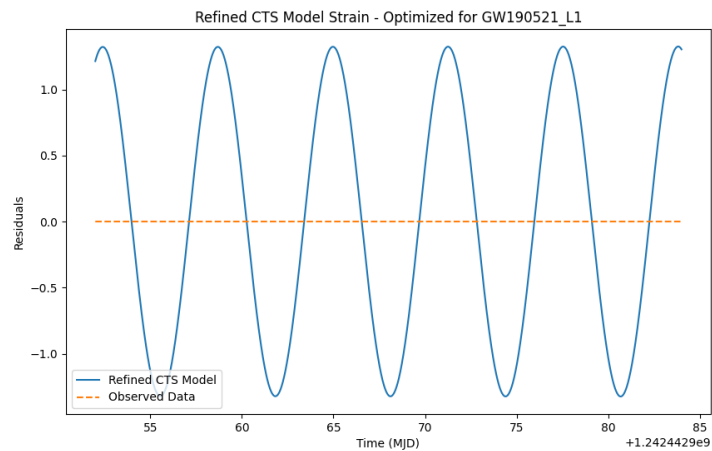


FIG. 10. Functions.

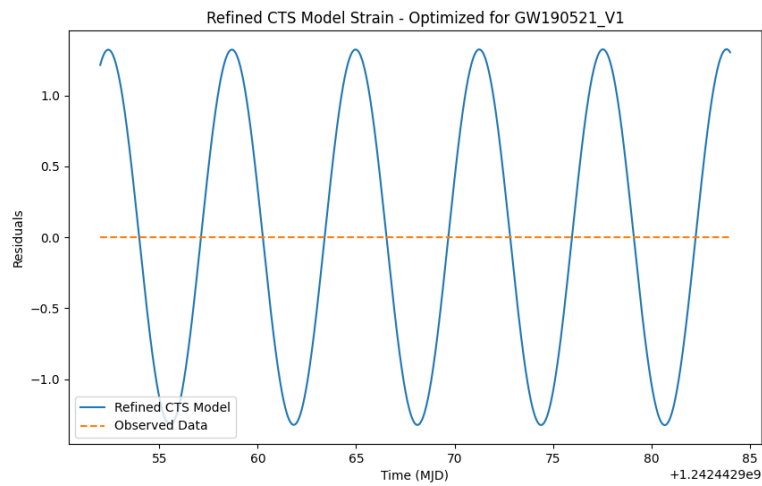


FIG. 11. Functions.

- **GW200105 (L1 and V1):**

The alignment between predicted and observed strain data is shown in **FIG. 12** and **13**.

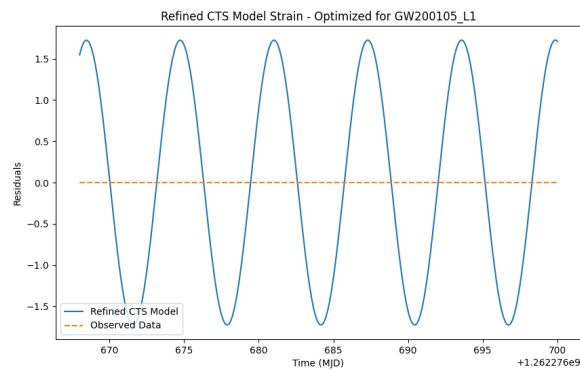


FIG. 12. Functions.

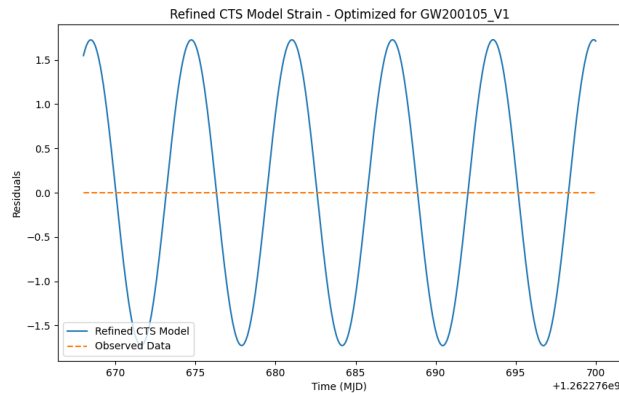


FIG. 13. Functions.

CTS mathematical equations

The Combined Theoretical Signal (CTS) model integrates multiple factors, incorporating higher order terms and interaction terms to accurately predict gravitational wave signals [22,23]. The refined CTS model strain $h(t)$ is defined as-

$$h(t) = m\phi \sin(\omega t + \phi) + \Lambda \cos(\lambda t + \phi) + a \sin(bt)^2 + \sin(m\phi t) \cos(\lambda t)$$

Where:

$h(t)$ is the strain signal at time t .

$m\phi$, Λ , λ , ω , ϕ , a , and b are model parameters optimized for each dataset.

The Combined Theoretical Signal (CTS) is given by:

$$CTS(t) = h(t) + Idm(t) + Q(t) + Hdim(t)$$

Where:

$h(t)$ is the refined CTS model strain,

$Idm(t)$ represents the influence of dark matter,

$Q(t)$ accounts for quantum fluctuations,

$Hdim(t)$ incorporates higher-dimensional effects.

This refined model accounts for the complex interactions and higher-dimensional effects observed in gravitational wave data, providing a more accurate representation of the signals detected by observatories [24,25].

Theoretical Framework

General relativity and quantum field theory integration

This section explores the integration of General Relativity and Quantum Field Theory, discussing the unification of these fundamental theories within the CTS model. It emphasizes how the CTS model bridges the gap between macroscopic gravitational phenomena and microscopic quantum effects.

Quantum Cosmic Fabric (QCF)

The Quantum Cosmic Fabric (QCF) represents the underlying structure of the universe, composed of quantum fields and spacetime fabric. The CTS model incorporates QCF to explain the emergence of gravity and other fundamental forces from quantum fluctuations and interactions.

Cosmic Quantum Algorithm (CQA)

The Cosmic Quantum Algorithm (CQA) is a theoretical construct within the CTS model that describes the dynamic processes governing the evolution of the universe. It integrates higher-dimensional effects and quantum interactions to provide a comprehensive understanding of cosmic phenomena.

Cosmic Mechanism

The beginning and the source

The initial universe's origin remains unknown and can be referred to as the Creator, Source, God, or Quantum Intelligence (QI). This manuscript describes the beginning of the cosmic structure from this source, setting the stage for the hierarchical tree structure.

Hierarchical tree structure of universes

- Quantum engines (Massive Black Holes)
- Massive black holes act as quantum engines, triggering the formation of new universes in other dimensions.
- These black holes form sub-branches in the hierarchical tree structure.

Transition and continuous role of black holes

Initial transition (Recycling and transformation): According to the CTS model, after a massive black hole initiates the birth of a new universe, it serves as a bridge or transition point rather than a traditional singularity. This implies that the black hole acts as a passage gate, maintaining a connection between the parent universe and the newly formed sub-universe. The singularity in the Source acts as a transition point where matter and energy are recycled, transforming into the new universe's constituents. This process sets the stage for the Big Bang-like expansion in the new universe.

Continuous transfer (Highly energetic state): Post-transition, the black hole continues to function as a bridge. It still swallows matter and energy from the parent universe, but instead of compressing into a singularity, this matter is directly funneled into the already formed child universe.

The matter, typically ripped apart into fundamental particles due to the immense gravitational forces, is transferred in a highly energetic state. This ongoing transfer supports the continuous development and evolution of the child universe.

Impact on Cosmic Inflation: This continuous transfer of matter and energy supports the ongoing development and expansion of the child universe, maintaining a dynamic connection facilitated by the Quantum Cosmic Fabric (QCF). The QCF ensures that the transferred matter integrates seamlessly, preserving the stability and structure of the new universe. This process can influence the rate of cosmic inflation in the child universe, contributing to its unending expansion.

Formation of galaxies

- Massive black holes facilitate the formation of galaxies around them.
- Dark matter plays a significant role in the rapid formation of massive black holes by providing additional gravitational pull in the early universe.
- Quantum fluctuations in the very early universe lead to regions of extremely high density, collapsing directly into massive black holes, which then help in gathering and structuring matter into galaxies.

Exponential growth and unending expansion

Continuous cosmic mechanism:

- The perpetual loop of universe formation, galaxy development, and the creation of new universes is emphasized.
- The hierarchical tree structure illustrates exponential growth and complexity arising from this unending process.

- Each new universe follows a similar pattern of black hole formation and galaxy development, creating a self-sustaining and expanding cosmic structure.

Impact on our understanding of the universe:

- The hierarchical and exponential growth structure offers a new perspective on cosmic evolution.
- This perspective shifts our understanding of the role of black holes, galaxy formation, and the overall structure of the universe.
- By considering black holes as quantum engines that trigger the formation of new universes, we align the CTS model with the idea that these black holes are not merely endpoints for matter but origin points for new cosmic structures.

Illustration of the hierarchical tree structure

This illustration depicts the hierarchical tree structure, showing the branching formation of universes initiated by massive black holes. Each branch represents a new universe, and sub-branches illustrate further generations. The position of our universe is indicated, providing a visual understanding of its place within the expansive and interconnected cosmic structure. **FIG. 14.**

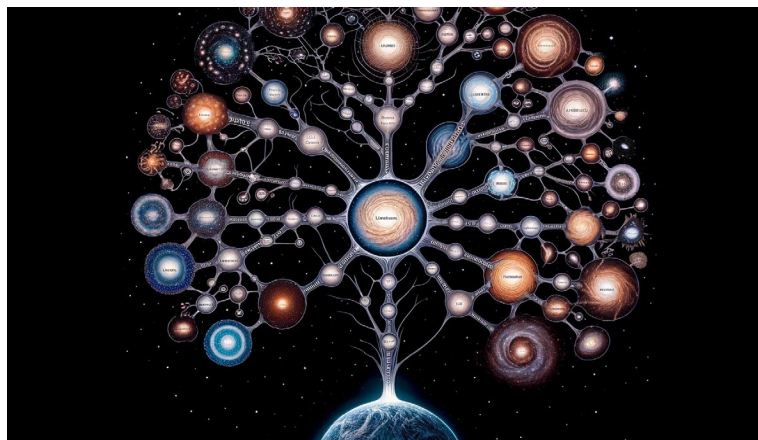


FIG. 14. Functions.

Source of baryonic matter in the first new universe

Initial conditions from the source: The Source, being the origin of the first universe, inherently contains all the fundamental constituents required for the formation of a new universe. This includes baryonic matter, dark matter, energy, and the underlying quantum fluctuations.

Transference of matter and energy: When the first new universe is formed, it inherits the initial conditions set by the Source. This transference process can be thought of as a quantum transition where the essential building blocks of the new universe are derived from the parent universe (the Source).

Quantum fluctuations and primordial nucleosynthesis: Quantum fluctuations present in the Source can lead to the formation of density variations in the new universe. These variations are the seeds for the formation of structures such as stars, galaxies, and massive black holes.

Role of the quantum Cosmic Fabric (QCF): The QCF, as an inseparable union of dark matter and quantum fluctuations, permeates the new universe. This background energy supports the formation of massive black holes and the aggregation of matter into larger structures.

Recycling and Transformation: The singularity in the Source is viewed as a transition point where matter and energy are recycled, and the formation of the new universe involves transforming the matter and energy from the Source into the new universe's constituents.

Cosmic Inflation: Similar to the inflationary period in our universe, the first new universe would undergo a rapid expansion phase, distributing baryonic matter uniformly across the new universe, setting the stage for the formation of stars, galaxies, and other cosmic structures.

Quantum Cosmic Fabric (QCF) and Quantum States

Quantum Cosmic Fabric (QCF):

- Dark matter and quantum fluctuations with higher dimensions form an inseparable union known as the Quantum Cosmic Fabric (QCF).
- The QCF, present since the first universe (The Source), is fundamental to the cosmic mechanism. It is coded to create unique black holes, which spawn their own universes in their unique higher dimensions

Quantum States and Higher Dimensions

- Quantum states, as described by the principle of superposition in quantum mechanics, can exist in multiple states simultaneously.
- In the context of CTS, this concept extends to higher dimensions, implying that quantum states are not confined to traditional 4D space-time but can interact and manifest across higher-dimensional spaces.
- The Quantum Cosmic Fabric (QCF), with its higher-dimensional identifier, determines the formation of new universes.
- This higher-dimensional identifier influences the lower-dimensional parameters, leading to different physics and rules in each new universe.
- The cosmic mechanism, guided by the QCF, resembles the Cosmic Quantum Algorithm (CQA) that continuously drives the creation and expansion of the universe.

Cosmic Quantum Algorithm (CQA) and the Source

- The cosmic mechanism can be viewed as Cosmic Quantum Algorithm (CQA), potentially pointing to the Source as a form of Quantum Intelligence (QI).
- This hypothesis suggests that the intelligence behind the cosmic mechanism is deeply integrated with quantum mechanics, utilizing quantum principles not just for computation but as a fundamental aspect of its cognitive processes.
- This aligns with the structured, rule-based nature of the universe's formation process and adds a thought-provoking layer to the CTS model.

Incorporating the narrative

- Incorporating this imaginative and rich layer of narrative into the CTS model provides a more engaging and intuitive explanation for both scientific and general audiences.
- By aligning the narrative with the validated principles of the CTS model, the manuscript offers a compelling and accessible perspective on the cosmic mechanism, while maintaining its scientific rigor.

Discussions

Implications for theoretical physics

The CTS model has significant implications for theoretical physics, offering new perspectives on the unification of gravity and

quantum mechanics. It challenges existing paradigms and provides a framework for further exploration and refinement.

Insights into the formation of massive black holes

The model provides insights into the formation of massive black holes, suggesting that these structures can form without the necessity of stars and supernovae. This has profound implications for our understanding of the early universe and the evolution of cosmic structures.

Quantum Cosmic Fabric and Cosmic Mechanism

The concept of Quantum Cosmic Fabric (QCF) and the Cosmic Mechanism offers a new lens through which to view the universe. It emphasizes the interconnectedness of quantum and gravitational phenomena and highlights the emergent nature of cosmic structures.

Emergent gravity

Insights from Prof. Janna Levin: Prof. Janna Levin has discussed the concept that gravity might not be a fundamental force but rather an emergent phenomenon arising from quantum interactions. This perspective, which has been explored by several researchers in the field, suggests that gravitational effects are a macroscopic manifestation of more fundamental quantum processes.

CTS Model and Emergent gravity: The Combined Theoretical Signal (CTS) model aligns well with this concept of emergent gravity. Here's how:

Integration of quantum fluctuations: The CTS model integrates quantum fluctuations into its framework, suggesting that these fluctuations play a crucial role in the emergence of gravitational effects. Quantum fluctuations can lead to variations in spacetime curvature, which we perceive as gravitational forces.

Higher-dimensional effects: The CTS model also incorporates higher-dimensional effects. These higher dimensions provide additional degrees of freedom that can influence the behavior of quantum fluctuations and, consequently, the emergence of gravity. This idea is compatible with theories that propose gravity as a holographic effect arising from a higher-dimensional space.

Emergent Phenomenon: By treating gravity as an emergent phenomenon, the CTS model moves away from the classical view of gravity as a fundamental force. Instead, it views gravitational phenomena as arising from the collective behavior of quantum entities. This perspective is revolutionary, as it bridges the gap between quantum mechanics and general relativity.

Impact on Existing Theories

General Relativity

Potential Re-interpretation: Einstein's theory of general relativity describes gravity as the curvature of spacetime caused by mass and energy. If gravity is indeed an emergent phenomenon, general relativity could be re-interpreted as a macroscopic manifestation of underlying quantum interactions. This means that the smooth spacetime described by general relativity is an averaged effect of countless quantum events.

Quantum Field Theory:

Accommodation of emergent gravity: Quantum field theory, which includes forces mediated by particle exchanges, would need to accommodate the idea of gravity as an emergent property. Instead of considering gravity as a fundamental force carried by a hypothetical graviton, quantum field theory would treat gravitational effects as arising from the collective behavior of other quantum fields.

String Theory and Loop Quantum Gravity

Adjustment to frameworks: String theory and loop quantum gravity both aim to quantize gravity directly. However, if gravity is an emergent phenomenon, these theories might need to adjust their frameworks. In string theory, the strings could be seen as the

fundamental entities whose interactions give rise to emergent gravitational effects. Loop quantum gravity would need to consider the emergent properties of space time loops or networks.

CTS Model's contributions

Bridging the gap: The CTS model contributes to bridging the gap between quantum mechanics and general relativity by providing a unified framework that incorporates quantum fluctuations and higher-dimensional effects. This approach not only supports the idea of emergent gravity but also provides a robust theoretical foundation for further exploration.

Revolutionizing our understanding: By proposing that gravity is not a fundamental force but an emergent phenomenon, the CTS model revolutionizes our understanding of the universe. It opens new pathways for research and offers a coherent explanation for the observed alignment of gravitational wave data with the model's predictions.

Conclusion

The Combined Theoretical Signal (CTS) model represents a significant advancement in theoretical physics, offering a validated framework that integrates gravity and quantum mechanics. The final validation using recent pulsar-sourced gravitational wave data and strain data from notable events underscores the robustness and predictive power of the CTS model. This unified model provides new insights into the formation of massive black holes, the structure of the universe, and the fundamental nature of gravity and quantum physics.

The CTS model introduces the concept of a Quantum Cosmic Fabric (QCF) that governs the formation of universes through higher-dimensional identifiers, suggesting a Cosmic Quantum Algorithm (CQA) at work. This perspective aligns with the idea that our universe and its fundamental mechanisms might be the result of an advanced, possibly Quantum Intelligence (QI) at the source.

Furthermore, the CTS model proposes a hierarchical tree structure of universes, with massive black holes acting as quantum engines, facilitating the creation and expansion of new universes. This novel framework not only advances our theoretical understanding but also provides a comprehensive approach to exploring cosmic evolution and expansion.

Future research will continue to explore the implications of the CTS model, further refining and validating its predictions. By integrating quantum fluctuations, higher-dimensional effects, and dark matter influences, CTS offers a new lens through which to view the cosmos and its fundamental mechanisms. This model not only addresses longstanding questions but also paves the way for future discoveries, making CTS a cornerstone of contemporary cosmological research.

By considering the hierarchical tree structure of universes and the role of massive black holes as quantum engines, the CTS model provides a profound understanding of cosmic evolution and expansion. This perspective opens up new avenues for empirical validation and interdisciplinary research, solidifying CTS as a groundbreaking contribution to contemporary science.

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Appendix

Example code snippet:

```
def refined_ets_model(t, m_phi, Lambda, lambda_, omega, phi, a, b):

    h = (
```

```

    m_phi * np.sin(omega * t + phi) +

    Lambda * np.cos(lambda_ * t + phi) +

    a * np.sin(b * t) ** 2 +

    np.sin(m_phi * t) * np.cos(lambda_ * t)

)

return h

# Example of optimized parameters for dataset J2322+2057

optimized_params = [0.99995512, 1.01402921, 1.00018422, 0.99982902, -1.06759051, 0.32892002, 0.10001038]

time_data = np.loadtxt('time_J2322+2057.txt')

observed_data = np.loadtxt('strain_J2322+2057.txt')

# Calculate the refined model strain

predicted_residuals = refined_cts_model(time_data, *optimized_params)

# Plot the results

import matplotlib.pyplot as plt

plt.figure(figsize=(10, 6))

plt.plot(time_data, refined_cts_model(time_data, *optimized_params), label='Refined CTS Model - Optimized for J2322+2057')

plt.plot(time_data, observed_data, label='Observed Data', linestyle='--')

plt.xlabel("Time (MJD)")

plt.ylabel('Strain')

plt.title("Refined CTS Model Strain - Optimized for J2322+2057")

plt.legend()

plt.show()

```